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Dr. Middleton PHYS 132 HW

4-10-17

CQ: 6

P: 12, 18, 20, 22

Ch. 34

Problems

34.P.12

$E_0 = v_{em} B_0$

$B_0 = 2.0 \times 10^{-3} T$

$v_{em} = 3.0 \times 10^8 m/s$

$E_0 = (3.0 \times 10^8 m/s)(2.0 \times 10^{-3} T)$

$E_0 = 6.0 \times 10^5 \ V/m$

$E_0 = 6.0 \times 10^5 \ V/m$

34.P.18

$I = \frac{1}{2} c \varepsilon_0 E_0^2$

$c = 3.0 \times 10^8 \text{ m/s}$

$\varepsilon_0 = 8.85 \times 10^{-12} \frac{C^2}{Nm^2}$

$E_0 = 300 \times 10^{-6} \text{ V/m}$

$I = \frac{1}{2}(3.0 \times 10^8 \text{ m/s})(8.85 \times 10^{-12} \frac{C^2}{Nm^2})(300 \times 10^{-6} \text{ V/m})^2$

$I = 1.19 \times 10^{-10} \text{ W/m}^2$

$I = 1.2 \times 10^{-10} \text{ W/m}^2$

34.P.20

$P = 200\ \mu W$

$r = 1.0 \times 10^{-6}\ m$

$E_0 = 2.2 \times 10^{11}\ V/m$

$\frac{E_0}{E_1} = 0.43$

a.) $I = \frac{P}{A}$, $I = \frac{1}{2} c \epsilon_0 E_0^2$

$\epsilon_0 = 8.85 \times 10^{-12}\ \frac{C^2}{Nm^2}$

$c = 3.00 \times 10^8\ m/s$

$r = 1.0 \times 10^{-6}\ m$

$P = 200 \times 10^{-6}\ W$

$A = \pi (1.0 \times 10^{-6}\ m)^2$

$\frac{P}{A} = \frac{1}{2} c \epsilon_0 E_0^2$

$\frac{2P}{A} = c \epsilon_0 E_0^2$

$\sqrt{\frac{2P}{Ac\epsilon_0}} = E_0 \quad : \quad \sqrt{\frac{2(200 \times 10^{-6}\ W)}{(\pi)(1.0 \times 10^{-6}\ m)^2 (3.0 \times 10^8\ m/s)(8.85 \times 10^{-12}\ \frac{C^2}{Nm^2})}}$

$E_0 = 2.2 \times 10^{11}\ V/m$

b.) $E = \frac{k q}{r^2}$

$k = 8.99 \times 10^9\ Nm^2/C^2$

$q = 1.602 \times 10^{-19}\ C$

$r = 0.063\ nm$

$E = \frac{\left(8.99 \times 10^9\ \frac{Nm^2}{C^2}\right)(1.602 \times 10^{-19}\ C)}{(0.063 \times 10^{-9}\ m)^2}$

$E_1 = 5.13 \times 10^{11}\ V/m$

$\frac{E_0}{E_1} = \frac{2.2 \times 10^{11}\ V/m}{5.13 \times 10^{11}\ V/m} = 0.43$

34.P.22

$P = 10\,W$

$B = 1.0 \times 10^{-6}\,T$

$v_{em} = 3.0 \times 10^{8}\,m/s$

$E_0 = v_{em} B_0 \qquad I = \frac{P}{4\pi r^2} \qquad I = \frac{1}{2} c \varepsilon_0 E_0^2$

$E_0 = (3.0 \times 10^{8}\,m/s)(1.0 \times 10^{-6}\,T)$

$E_0 = 300\,V/m$

$$\frac{P}{4\pi r^2} = \frac{1}{2} c \varepsilon_0 E_0^2$$

$$\frac{4\pi r^2}{P} = \frac{1}{\frac{1}{2} c \varepsilon_0 E_0^2}$$

$$4\pi r^2 = \frac{2P}{c \varepsilon_0 E_0^2}$$

$$r = \sqrt{\frac{2P}{4\pi c \varepsilon_0 E_0^2}}$$

$r = 8.16 \times 10^{-2}\,m$

$P = 10\,W$

$c = 3.00 \times 10^{8}\,m/s$

$\varepsilon_0 = 8.85 \times 10^{-12}\,\frac{C^2}{Nm^2}$

$E_0 = 300\,V/m$

$r = 0.082\,m$

Conceptual

34.CQ.6

a.) No this can't happen because it is in the other direction as indicated.

b.) This can happen because it is in the correct direction.